# From polymers to proteins – novel phases of short compact tubes

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**Abstract**

A framework is presented for understanding the common character of proteins. Proteins are linear chain molecules – however, the simple model of a polymer viewed as spheres tethered together does not account for many of the observed characteristics of protein structures. We show here that the notion of a tube of non-zero thickness allows one to bridge the conventional compact polymer phase with a novel phase employed by Nature to house biomolecular structures. We build on the idea that a non-singular continuum description of a tube (or a sheet) of arbitrary thickness entails discarding pairwise interactions and using appropriately chosen many body interactions. We suggest that the structures of folded proteins are selected based on geometrical considerations and are poised at the edge of compaction, thus accounting for their versatility and flexibility. We present an explanation for why helices and sheets are the building blocks of protein structures.

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